

VIBRATION SWITCH WITH AXIALLY EXTENDING DEFLECTABLE ELECTRIC CONTACT

BACKGROUND OF THE INVENTION

1. Field of the Invention

5 This invention relates to a vibration switch, more particularly to a vibration switch with an axially extending deflectable electric contact body which has two ends anchoring on two side walls of a housing and an intermediate portion that is deflectable so as to make an
10 electrical connection between two electric contact terminals.

2. Description of the Related Art

 Figs. 1 to 3 show a vibration switch 1, which is disclosed in U.S. Patent No. 6,545,235 B1 granted to the applicant
15 of the present invention. The vibration switch 1 includes an electrically conductive housing 11, a coil spring 12, and first and second electric contact terminals 114, 14. The housing 11 defines an accommodation chamber 112 therein. The first electric contact terminal 114 extends downwardly
20 from a side wall 1122 of the housing 11. The second electric contact terminal 14 passes through an insulating plug member 13 fitted in an open end 1121 of the housing 11 so as to extend into the accommodation chamber 112. The coil spring 12 has an anchoring end 121 which anchors on a stem
25 portion 113 secured on the side wall 1122, and a deflectable segment 123 which extends from the anchoring end 121 towards the second electric contact terminal 14 to terminate at

a contact terminal end 122. By virtue of the biasing force of the deflectable segment 123 that acts against the weight thereof, the contact terminal end 122 is held in such a manner as to surround the second electric contact terminal 14. As shown in Fig. 3, once the housing 11 is jerked by means of a force (F), the contact terminal end 122 is deflected radially as a result of an inertial force of the deflectable segment 123 so as to contact the second electric contact terminal 14, thereby making an electrical connection between the first and second electrical contact terminals 114, 14.

The vibration switch 1 can provide a stable electrical connection between the electric contact terminals 14, 114. However, since only the anchoring end 121 of the coil spring 12 is secured relative to the housing 11, the contact terminal end 122 tends to droop, and may undesirably contact the second electric contact terminal 14, thereby resulting in a contact error.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a vibration switch in which a deflectable electric contact body can be supported firmly so as to minimize undesired contact of the contact body with an electric contact terminal.

According to this invention, the vibration switch includes a housing, first and second electric contact terminals, and a deflectable electric contact body.

The housing is adapted to be mounted on a support in an upright direction, and has first and second side walls spaced apart from each other along an axis in a longitudinal direction transverse to the upright direction, and a surrounding wall interposed between and cooperating with the first and second side walls to confine an accommodation chamber thereamong.

The first electric contact terminal has a first connecting end which is adapted to be connected to the support, and a first contact end which extends from the first connecting end to confront the accommodation chamber.

The second electric contact terminal is disposed to be electrically insulated from the first electric contact terminal, and has a second connecting end which is adapted to be connected to the support, and a second contact end which extends from the second connecting end into the accommodation chamber proximate to the second side wall. When the vibration switch is in a stable position, the second contact end is electrically insulated. The second contact end is spaced apart from the first contact end within the accommodation chamber.

The deflectable electric contact body is disposed in the accommodation chamber, and has first and second anchoring ends which are opposite to each other in the longitudinal direction and which are disposed to anchor on the first and second side walls, respectively, and an intermediate portion which is interposed between the first

and second anchoring ends. The intermediate portion is made from a deflectable material, and includes a deflecting segment, and first and second deflected segments that flank the deflecting segment and that are respectively proximate to the first and second anchoring ends so as to be deflected with the deflecting segment in the same direction. The deflecting segment is configured in such a manner as to acquire a biasing force such that, by virtue of the biasing force that acts against weight of the deflecting segment, the first and second contact ends are held in the stable position, and such that, when the housing is jerked out of the stable position, the deflecting segment, together with the first and second deflected segments, is deflected in a direction radial to the axis as a result of an inertial force thereof, thereby bringing at least one of the deflecting segment and the first and second deflected segments into electric contact with at least one of the first and second contact ends.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the present invention will become apparent in the following detailed description of the preferred embodiments of the invention, with reference to the accompanying drawings, in which:

Fig. 1 is an exploded perspective view of a conventional vibration switch;

Figs. 2 and 3 are sectional view of the conventional vibration switch in switch-off and switch-on states,

respectively;

Fig. 4 is an exploded perspective view of the first preferred embodiment of a vibration switch according to this invention;

5 Figs. 5 and 6 are sectional views of the first preferred embodiment in switch-off and switch-on states, respectively;

Figs. 7 and 8 are sectional views of the second preferred embodiment of a vibration switch according to this invention in switch-off and switch-on states, respectively;

10 Figs. 9 and 10 are sectional views of the third preferred embodiment of a vibration switch according to this invention in switch-off and switch-on states, respectively;

15 Figs. 11 and 12 are sectional views of the fourth preferred embodiment of a vibration switch according to this invention in switch-off and switch-on states, respectively;

20 Figs. 13 and 14 are sectional views of the fifth preferred embodiment of a vibration switch according to this invention in switch-off and switch-on states, respectively;

25 Figs. 15 and 16 are sectional views of the sixth preferred embodiment of a vibration switch according to this invention in switch-off and switch-on states, respectively; and

Figs. 17 and 18 are sectional views of the seventh preferred embodiment of a vibration switch according to this invention in switch-off and switch-on states, respectively.

5 **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Referring to Figs. 4, 5 and 6, the first preferred embodiment of a vibration switch 2 according to the present invention is shown to comprise a housing 21, a plug member 22, first and second electric contact terminals 25, 24, and
10 a biasing deflectable electric contact body 23.

The housing 21 is adapted to be mounted on a support (not shown) in an upright direction, and has a first side wall 2112 and a surrounding wall 214 which extends from the first side wall 2112 in a longitudinal direction
15 transverse to the upright direction. The first side wall 2112 and the surrounding wall 214 cooperatively confine an accommodation chamber 211 with an opening end 2111 opposite to the first side wall 2112, and are made from an electrically conductive metal material. The plug member
20 22 is made from an insulating material, and is fittingly inserted into the opening end 2111 to serve as a second side wall of the housing 21, which is spaced apart from the first side wall 2112 along an axis in the longitudinal direction. The plug member 22 is provided with an anchored
25 protrusion 221 extending along the axis. The first side wall 2112 has an anchored recess 213 formed therein and confronting the anchored protrusion 221.

The first electric contact terminal 25 is formed integrally with the first side wall 2112. The first electric contact terminal 25 has a first connecting end 251 which projects outward from the first side wall 2112 and which is adapted to be connected to the support, and a first contact end 252 which extends from the first connecting end 251 to confront the accommodation chamber 211.

The second electric contact terminal 24 has a second connecting end 241 which is adapted to be connected to the support, and a second contact end 242 which extends from the second connecting end 241 through the plug member 22 along the axis into the accommodation chamber 211 so as to be spaced apart from the first contact end 252 of the first electric contact terminal 25 within the accommodation chamber 211. As such, when the vibration switch 2 is in a stable position as shown in Fig. 5, the second contact end 242 is electrically insulated from the first electric contact terminal 25.

The deflectable electric contact body 23, such as a coil spring made from an electrically conductive material, is disposed in the accommodation chamber 211. The coil spring 23 includes a plurality of loops wound spirally about the axis. The coil spring 23 has a first anchoring end 231 which is retained in the anchored recess 213, a second anchoring end 232 which is opposite to the first anchoring end 231 in the longitudinal direction and which is retained on the anchored protrusion 221, and an intermediate portion 233

which is interposed between the first and second anchoring ends 231,232 and which is disposed to surround the second contact end 242 of the second electric contact terminal 24. As such, the first anchoring end 231 is electrically connected to the first contact end 252 of the first electric contact terminal 25.

The intermediate portion 233 includes a deflecting segment 2331, and first and second deflected segments 2332,2333 that flank the deflecting segment 2331 and that are respectively proximate to the first and second anchoring ends 231,232 so as to be deflected with the deflecting segment 2331 in the same direction. Preferably, a first distance defined between two adjacent ones of the loops at each of the first and second deflected segments 2332,2333 along the axis is larger than a second distance defined between two adjacent ones of the loops at the deflecting segment 2331 along the axis. In addition, the loops at the deflecting segment 2331 have an inner diameter which is smaller than that of the loops at the first and second deflected segments 2332,2333. The deflecting segment 2331 is configured in such a manner as to acquire a biasing force such that, by means of the biasing force that acts against weight of the deflecting segment 2331, the first and second contact ends 252,242 are held in the stable position. Referring to Fig. 6, when the housing 21 is jerked out of the stable position by a force (F), the deflecting segment 2331, together with the first and second

deflected segments 2332,2333, is deflected in a direction radial to the axis as a result of an inertial force thereof, thereby bringing at least one of the deflecting segment 2331 and the first and second deflected segments 2332,2333 into electric contact with the second contact end 242, thereby making an electrical connection between the first and second electric contact terminals 25,24.

Referring to Figs. 7 and 8, the second preferred embodiment of a vibration switch 3 according to this invention is shown to be similar to the first embodiment in construction, and includes a housing 31, a plug member 32, first and second electric contact terminals 35,34, and a coil spring 33. In this embodiment, instead of the anchored protrusion, an anchored recess 321 is formed in the plug member 32 for retaining the second anchoring end 332 of the coil spring 33. Since the operation of the vibration switch 3 is similar to that of the first preferred embodiment, a description thereof is omitted herein for the sake of brevity.

Referring to Figs. 9 and 10, the third preferred embodiment of a vibration switch 4 according to this invention is shown to include a housing 41, a plug member 42 fitted into an opening end of the housing 41, a first electric contact terminal 45 extending from the housing 41 opposite to the plug member 42, a second electric contact terminal 44 extending through the plug member 42 and having a contact end 442 disposed in the housing 41, and a coil

spring 43 having a plurality of loops with a uniform inner diameter. The contact end 442 has an enlarged contact head 4421 which is disposed within the loops at the deflecting segment 4331 of the intermediate portion 433 of the coil spring 43 so as to facilitate contact between the contact end 442 and the loops when the housing 41 is jerked out of the stable position.

Referring to Figs. 11 and 12, the fourth preferred embodiment of a vibration switch 5 according to this invention is shown to include a housing 51, a plug member 52, first and second electric contact terminals 55, 54, and a coil spring 53. The first side wall of the housing 51 has an insulating protrusion 513 which extends towards the plug member 52 along the axis. The contact end 542 of the second electric contact terminal 54 has a block shape, and abuts against an inner side surface 521 of the plug member 52. The first and second anchoring ends 531, 532 of the coil spring 53 are retainingly sleeved on the insulating protrusion 513 and the contact end 542, respectively, such that the second anchoring end 532 is electrically connected to the second electric contact terminal 54. As such, when a force (F) is applied to the housing 51, the intermediate portion 533 of the coil spring 53 can be deflected to come into electric contact with the contact end of the first electric contact terminal 55 so as to make an electrical connection between the first and second electric contact terminals 55, 54.

Referring to Figs. 13 and 14, the fifth preferred embodiment of a vibration switch 6 according to this invention is shown to be similar to the fourth embodiment in construction, except that the second anchoring end 632 of the coil spring 63 is sleeved retainingly on the anchored protrusion 621 of the insulating plug member 62. The contact end 642 of the second electric contact terminal 64 extends through the anchored protrusion 621, and engages the second anchoring end 632 to make an electrical connection therebetween. Since the operation of the vibration switch 6 is similar to that of the fourth embodiment, a description thereof is omitted herein for the sake of brevity.

Referring to Figs. 15 and 16, the sixth preferred embodiment of a vibration switch 7 according to this invention is shown to include a housing 71, a plug member 72, first and second electric contact terminals 75, 74, and a coil spring 73 of a deflectable electric contact body. An insulating protrusion 713 extends towards the plug member 72 along the axis. The second electric contact terminal 74 includes a stem portion 743 which is inserted into and which is retained in the plug member 72. The contact end 742 of the second electric contact terminal 74 includes a block portion 7422 which extends from the stem portion 743 into the accommodation chamber of the housing 71 and which abuts against an inner side surface 721 of the plug member 72, and a rod portion 7421 which is disposed within the loops at the second deflected segment 7332 of the

intermediate portion 733 of the coil spring 73. The first and second anchoring ends 731, 732 of the coil spring 73 are sleeved on the insulating protrusion 713 and the block portion 7422, respectively. The deflectable electric contact body further has a weight member 76 in form of a ball, which is rollably retained in the loops at the deflecting segment 7331, and which has a diameter (L1) that is smaller than the distance (D1) between the insulating protrusion 713 and the rod portion 7421. By means of the weight member 76, the weight of the deflecting segment 7331 can be increased so as to augment the inertial force of the deflecting segment 7331 when the housing 71 is jerked out of the stable position, thereby enhancing the sensitivity of the vibration switch 7.

Referring to Figs. 17 and 18, the seventh preferred embodiment of a vibration switch 8 according to this invention is shown to include a housing 81 made from an insulating material, an insulating plug member 82, rod-shaped first and second electric contact terminals 85, 84, and a deflectable electric contact body including a coil spring 83 and a ball-shaped weight member 86. The first and second contact ends 852, 842 are surrounded by the loops at the first and second deflected segments 8332, 8333, respectively. The weight member 86 is rollably retained in the loops at the deflecting segment 8331, and has a diameter (L2) that is smaller than the distance (D2) between the first and second contact ends 852, 842 such that

the coil spring 83 is electrically insulated from both the first and second electric contact terminals 85,84. When a force (F) is applied to the housing 81, the first and second deflected segments 8332,8333 are brought into electric contact with the first and second contact ends 852,842, respectively, by the deflecting segment 8331 as a result of an inertial force of the deflecting segment 8331, thereby establishing an electrical connection between the first and second electric contact terminals 85,84. Also, the weight of the deflecting segment 8331 can be increased by means of the weight member 86 so as to increase the inertial force of the deflecting segment 8331.

As illustrated, since the deflectable electric contact body of the vibration switch according to this invention has two anchoring ends anchoring on the two side walls of the housing, better support for the deflectable electric contact body can be achieved to thereby minimize undesired contact of the deflectable electric contact body with an electric contact terminal when the housing is in a stable state.

While the present invention has been described in connection with what is considered the most practical and preferred embodiments, it is understood that this invention is not limited to the disclosed embodiments but is intended to cover various arrangements included within the spirit and scope of the broadest interpretations and equivalent arrangements.